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Fertilizer Placement Tests With Potatoes[1]

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Experiments with corn and cotton have shown that the placement of the fertilizer with respect to the seed may make a very decided difference in the yield of the crop. Generally the nearer the fertilizer can be placed to the seed without injuring it, the better the results. The conclusion has been that by devising better means of applying the fertilizer for these crops considerably less fertilizer can be used to obtain the same results as with the larger amounts being used with present methods.

A search of the literature shows that very little work has been done on methods of applying fertilizer for potatoes. Usually the potato planters are built so that the fertilizer is placed at the sides of the seed pieces. It has beeen assumed that this is the most effective way, but there is very little experimental data to either substantiate or refute this.

Coe[2] at the New Jersey Station applied fertilizer for potatoes in 13 different ways. Applying it at the side of the seed or below it gave the best results.

Truog[3] found that applying the fertilizer either below the seed piece or at the sides gave better results than when applied above the seed or with it.

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[1]Published by permission of the Dirctor of the R. I. Agricultural Experimnt Station as Contribution No. 424.

[2]Coe, D. G. Fertilizing the Potato Crop—What is the best way to do it. In Hints to Potato Growers, N. J. State Potato Assoc. 2:10, 1922.

[3]Truog, E., et. al., Fertilizer Experiments. Wis. Agr. Expt. Sta. Research Bul. 65, 1925.

An experiment was started at the Rhode Island Station in 1926 in which five different methods have been compared. These tests have been conducted over a period of six years and have yielded some fairly definite results which are presented in this paper.

Potatoes are included in a number of crop rotation experiments that have been under way at the station for a period of about 35 years. The tests on fertilizer placement were made on the potato plats of one of these rotations (D) in 1926 and on three different rotations (B, C, D,) in each of the other five years. No manure is used for the potato crop in any of these rotations. Approximately one ton per acre of 4-8-7 fertilizer has been used. A description of these rotations may be found in Bulletin 224 of this station[1]. The soil where these rotation experiments are located is classified as a Merrimac silt loam. It is level and well drained.

The methods of fertilizer applications were as follows:

(1) Broadcast—The fertilizer was applied on top of the ground and harrowed in before the potatoes were planted.

(2) Cultivated in—A furrow was opened, the fertilizer placed in this, cultivated in with a cultivator, the furrow reopened and the potatoes planted.

(3) Below Seed—A furrow was opened, the fertilizer covered with a thin layer of soil and the potatoes planted.

(4) Above Seed—The potatoes were placed in the furrow, covered with a thin layer of soil and the fertilizer spread over this.

(5) Side of Seed—A wide furrow was opened, the fertilizer spread in two narrow bands along both sides at the bottom of this and the seed placed in the center.

The yields obtained are shown in Table 1.

Since the only two treatments that were continued over the entire period were "above" and "below" seed placements, it is necessary to use averages over different periods. The conditions from year to year will usually differ to a considerable degree so that only averages for the same years should be compared.

Considering first the results for 1926-27 it is seen that the broadcast application yielded (column 3), on the average for

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[1]Odland, T. E., Damon, S. C., and Tennant, J. L. Fertilizer and crop rotation expriments. R. I. Agr. Expt. Sta Bul. 224, 1930.

these two years, considerably below the others. The same is true for the 1930-31 period when this treatment was again included in the comparison.

The average yield where the fertilizer was placed below the seed was 347 bushels per acre over the 6-year period and 327 bushels where it was placed above the seed. Although this is not a large average difference the yields have been rather consistent in favor of the "below" seed application and justifies the conclusion that of these two methods, the 'below" seed placement may be expected to give the best results.

TABLE 1. Yields in bushels per acre of potatoes with different methods of fertilizer application.

Year	Rotation	Broadcast	Cultiv'ed in furrow	Below Seed	Above Seed	Side of Seed
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1926	D	339	384	408	346	
1927	B	217	349	366	340	
	C	300	439	434	399	
	D	324	379	413	369	
1928	B		284	352	344	354
	C		398	370	378	376
	D		370	358	373	353
1929	B		245	254	184	181
	C		241	255	246	248
	D		294	314	307	287
1930	B	233		374	364	380
	C	354		400	377	372
	D	355		468	455	445
1931	B	123		251	247	260
	C	233		293	281	232
	D	133		247	229	195
Averages						
1926-27		295	388	405	363	
1928-29			305	317	305	300
1930-31		238		339	325	314
1926-31				347	327	

In the four years where "cultivated in" fertilizer was compared with the "below" and "above" seed methods there was little difference in yield between the "above" seed and the "cultivated in" and "above" methods. The average yield for

the two years, 1926-27, was 388 bushels for the "cultivated in" and 363 for the "above" seed method. "Below" seed placement yielded 405 bushels for this period. For the 1928-29 period the "cultivated in" and "above" placements yielded the same; namely, 305 bushels per acre which was 12 bushels less than the "below" seed method.

In the four years that the "side of seed" (column 7) placement was compared with the "above" and 'below" placements, the average yield was a little less for this method than for either of the others. Again the differences were not great, the average yields being 300 and 314 bushels per acre for the two periods 1928-29, and 1930-31 respectively. Placing the fertilizer below the seed under these conditions has produced the better yields.

These tests showed a rather consistent although not large difference in yield in favor of placing the fertilizer below the seed when compared with other furrow placements. All furrow placements were superior to broadcast applications.

Tuber Indexing versus Tuber-uniting and Roguing in Seed Potato Production

F. M. HARRINGTON, Montana Experiment Station, Bozeman

Certified seed requirements nowadays are gradually becoming more rigid and buyers of such seed are becoming more exacting in their demands. It was only a few years back that seed purchasers failed to recognize such things as mosaic, spindle tuber, witches broom, and the like. Information as regards the effects of such diseases on total yield and grade has become so widespread that now a majority of seed buyers recognize these diseases. As a general thing seed users are not satisfied even with the total limit of 5 per cent as put on virus diseases and are demanding a type of seed which, when planted under their growing conditions, will produce in good shape and show mighty few diseased plants in the whole field.

Seed stocks are being produced generally in the northern states and in states which have areas of high elevation. This condition gives certain advantages in the way of seed growing, but also certain disadvantages. Unquestionably these areas have the advantage of better stocks and conditions which bring

about only a minimum spread of disease in the field. With these advantages, however, comes the point of difficulty in disease identification and roguing through an occasional combination of conditions which masks diseases in the field. The sections in which the seed is ultimately grown for a commercial crop generally have the opposite of northern conditions and the agencies for the spread of disease are much more numerous. In these fields, every diseased plant is plainly manifest due to a combination of favorable temperature and moisture conditions. The more severe forms of the diseases do not offer the problems in the northern states that is offered by the mild stages, particularly mild mosaic. Even mild mosaic, however, is objectionable to the commercial grower. He believes, and rightly so, that certified seed should contain a minimum of all of these diseases.

With the conditions under which seed is grown in the northern states, how are certified seed growers going to maintain their stocks at a high percentage of disease freedom for seed purchasers? We have in the past discussed tuberunit planting as an outstanding measure for the grower to employ in seed production. Undoubtedly the tuberunit method has made for marked improvement, and by rigidly tuberunit planting the seed plot for the production of foundation stock, the grower has materially improved the quality of the seed which he has to offer to prospective buyers. However, the northern states have been faced with two years of drought. Such years are bringing for consideration in 1932 a marked problem, particularly so far as mild mosaic is concerned. I anticipate that our inspectors in 1932 will run into much higher percentage of mosaic than they found in 1930 and 1931, provided temperature and moisture conditions are normal, and this entirely due to the extreme difficulty presented during the dry season in eliminating mosaic. I anticipate a higher percentage of rejections in 1932. A situation such as this always brings to the mind of the grower the question of whether the seed game is worth while. He has conscientiously performed his job, and then because of the conditions mentioned, finds his stock is not so good as he expected, nor is it good enough to meet seed requirements. Even in his tuberunit seed plot he has not been able to do as thorough a job of roguing as in other years and under the unfavorable conditions his seed stock is bound to slide back somewhat in value. With the education on diseases that has prevailed, the standards cannot be lowered for a particular year, but instead must necessarily come the question as to how such a situation can be met.

In connection with our experiment station work in Montana

we have two plots within four miles of the station, one irrigated and one dry land. We have regularly planted a sample of our growers' seed stocks in both fields. We have made disease readings on all of these stocks, and have taken yield records. This past season the readings in the dry land plot, particularly with respect to mosaic, were almost impossible to make. In the irrigated plot we had no difficulty in identifying diseases. The diseased plants were there and even though it was so dry there was no evidence whatsoever of aphis, nevertheless spread of disease did take place.

For a number of years we have been carrying tuberunit plots of both Bliss Triumph and Netted Gem potatoes. These plots we have rogued closely every year and by this method it has been possible for us to standardize much more closely the type of plant growth, but the dry land plot has furnished a discouraging element in that the next year we have had considerable roguing to do again and it has seemed that we could go just about so far in improvement work and then have to repeat the process next year in order to hold the stock to the point desired. Tuber indexing seems to be one of the answers in meeting some of these problems incidental to seed growing.

We started by indexing stock supplied by various growers. Some of these stocks in the field had been read as practically disease free. This proved to be the case with rugose mosaic, for example, but it decidedly was not the case with mild mosaic. The stocks had been grown by very careful, conscientious growers who had maintained a special tuberunit seed plot. We also began tuber indexing our own stocks, as referred to above. The first season's work showed a surprisingly high percentage of disease, chiefly mild forms. This tuber indexed stock, when planted back in the field was compared with a non-indexed stock. Close records were kept as to the number of plants rogued from both plots. In this respect the differences were very pronounced, in favor of the indexed stock. Yield records were also kept and were distinctly significant.

Tubers from the indexed field were again indexed the following winter and showed a very low disease reading this time as compared with the first. As a matter of fact some of this stock was indexed by three different agencies, with a very low disease reading in every case. We have come to the conclusion from watching the resuts during several years and observing the effects of tuberuniting and tuber indexing that the problem of the certified seed grower can never become a problem of the grower alone if he is to make a success of the business. He cannot equip himself for index work. At the same time if he is to

make a success of his business of seed growing he must have access to some such service.

We are working now toward a program of seed production in Montana which will involve a close tie-in between the state college and the grower. Our program is simply this. A certain quantity of tuber indexed seed stock will go back to the grower practically every year, if greenhouse space will permit, or at least every two years. The grower in turn will plant this indexed stock in an isolated tuberunit seed plot, watch it carefully and remove every objectionable plant that may show up. From this seed plot, depending on the volume of seed needed by the grower, his stock will either go directly to the commercial field or to an increase plot, also tuberunited and watched every day during the growing season. When such seed is then planted in the commercial seed field, it should furnish a high grade stock for the production of high quality commercial certified seed.

From the experience we have had with some of these problems, our immediate answer to the grower as to how he is going to meet the situation is this service of tuber indexing seed, to go into a special tuberunited seed plot to furnish good foundation stock for his operations. When we have this scheme worked out and functioning I believe that the bulk of the work of certified seed production will be confined to the index work plus intensive work in the small isolated, tuberunited seed plot as planted from the indexed seed. Thus the work required in the way of roguing in the larger commercial field will be greatly reduced. The operations of the grower will be reduced and the purchaser of the seed will receive better quality seed than he has in the past.

Recent Investigations of Potato Calico*

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Potato calico has been recognized since 1920 when Hungerford (1) described it as a non-infectious disease of minor importance in Idaho. It has since been reported from Oregon (3) (4), Washington (5), and Montana (6) and while it has been observed by the writer in Iowa its prevalence in those states east of the Rocky

*For a more detailed report see Hilgardia, 6, 9:277-294, 1931.

Mountains has not yet been established. The disease has been under investigation in California during three years and has been observed in every important potato producing district of the state, extending from San Diego in the extreme southern to Humboldt county in the extreme northern part. It was prevalent in certain fields of the San Joaquin delta in 1930 and growers in southern California have stated that calico is steadily increasing in prevalence in their fields even though they continue to plant only their own seed stock. In 1930 the per cent of infection in widely separated fields in the state varied from a trace to 91 per cent.

Symptoms in the Field—Some of the leaflets of infected plants growing in the field become irregularly spotted or blotched. These areas do not become necrotic, rather they appear devoid of chlorophyll and generally assume a bright or brilliant-yellow, yellowish white or gray color. The spots are not always inter-veinal but may occupy as much as 95 per cent of the leaflet area. As a probable result of chlorophyll deficiency, plants infected when young seldom attain normal size. If infected when nearly mature there appears to be no significant stunting. If more than 50 per cent of the plants in the field are infested, the crop appears diseased from a distance. Under conditions of close planting, as commonly practiced in the Delta region, non-infected plants often grow over and obscure plants which were infected when small. These symptoms are in agreement with those described by Hungerford (2) except that he did not notice significant stunting. McKay and Dykstra (3) working in Oregon, reported that diseased plants were stunted.

Symptoms in the Greenhouse—Under greenhouse conditions where insects are kept under control, steamed soil is used and air temperature conditions made favorable for expression of symptoms, calico is manifested by symptoms almost identical with those commonly observed in the field. It has been possible to measure stunting in the greenhouse, and it has been observed, as pointed out by Hungerford (2), that chlorophyll may develop in the infected leaflets as the plants become older. Infected plants are stunted, the leaflets are smaller and the leaves shorter than normal. The stems are usually smaller on diseased than on calico-free plants.

Effect on Yield—Infected plants selected at random in the field usually yield less than adjoining calico-free plants. During three seasons, relative yields of such plants have been measured, and the reduction due to calico infection was 31, 16, and 21 per cent. Under controlled conditions in the greenhouse, the yield reduction was 19 per cent.

Field Spread—Current season spread of potato calico has been

observed and measured every year since 1929, the evidence indicating the infectious nature of the disease. Plants manifesting calico symptoms have been staked, and subsequent infection of adjoining plants noted within 20 days. Tubers produced by "apparently calico-free" plants adjoining infected plants in the field, have produced calico plants under controlled greenhouse conditions.

In 1930, seed stock produced in Minnesota in 1929 and known to be free of calico, was planted in two fields on the same ranch in the Delta region. Field No. 1 was situated near the levee, while No. 2 was about one mile distant. In field No. 1 this seed was planted in two 40-foot strips, parallel with the levee, and separated from one another by a seven-foot space, four feet of which was occupied by an irrigating ditch about three feet deep.

Calico first appeared in those plants nearest the levee, the infection being 18 per cent on May 13th when only a trace could be found in those plants beyond the ditch. At the same time no calico was found in the distant field. On June 13th, the per cent of infection was, respectively 91, 46, and a trace for the three fields; indicating that infection had come from some source other than the seed stock, and that the disease had spread across the irrigating ditch between May 13th and June 13th. Infection probably came from volunteer potato plants growing near the levee or from hosts other than potatoes. In 1931, an isolated plot was planted with ten rows of healthy* stock, and one of calico infected, the latter being planted in a single row with five rows of healthy stock on either side. All of the infected tubers produced calico plants, the healthy stock remaining free of visible infection until the plants were three weeks old. At this time calico was observed in the two rows nearest the calico stock and with advancing age the disease spread until some infection was noted in the two outside rows of the plot.

Artificial Transmission by Leaflet Mutilation—While the evidence of field spread suggests the infectious nature of potato calico, proof is lacking until successful artificial inoculations, and subsequent transfer to healthy potato plants are made. Healthy stock of the variety White Rose, as well as potato seedlings have been successfully inoculated with calico, using unfiltered juice taken from infected plants. The disease has then been transferred from the infected White Rose and seedling stock to healthy stock and to seedlings. Leaflet inoculation has been effected as follows: (a) a drop of infectious juice was placed on the upper surface of the leaflet and 50 small needle pricks made

*In this paper healthy stock indicates tubers found free of calico.

through this juice into the tissue; (b) the fingers were moistened with infectious juice and the leaflet rubbed so as to cause surface injury and (c) sterilized cheesecloth was saturated with infectious juice and the upper leaflet surface rubbed so as to injure the epidermal cells and leaf hairs. Controls were inoculated as above with sterile distilled water.

Artificial Transmission by Tuber Grafting—Many attempts to transmit calico through the medium of tuber grafts have been made but a very low per cent of infection has been obtained by this method. In 1930, Dr. E. S. Schultz tuber-grafted 25 Green Mountain half-tubers with tissues from tubers produced by calico infected plants (secured in California) and planted them at Presque Isle, Maine. In a letter dated September 25, 1930, Dr. Schultz advised the writer that two of the 25 tuber-grafts produced plants which manifested symptoms of calico, while the ungrafted sister half-tubers produced calico-free plants. Although the results of this experiment suggest the infectious nature of the disease, the per cent of infection appears too low for adequate proof. Tuber-grafting experiments conducted by the writer have, in general, failed to transmit the disease. Failure to obtain a high per cent of infection may be due to incomplete diffusion of the infectious principle into tubers produced by infected plants, for neither all the tubers from an infected plant nor all the buds of an infected tuber always produce visibly infected plants. Thus, unless it is definitely known that the infectious principle is completely diffused in a tuber used for grafting into calico-free tubers, such complete diffusion might account for the nature of the results secured by Dr. Schultz and the writer.

Identity—Although calico, as known in Oregon, Idaho, Montana, and Washington, has not proven infectious, the similarity in symptoms manifested under California conditions with those produced in the other western states strongly indicated that the disease in question was really calico. Calico-infested tubers were secured from P. A. Young of the Montana station and Mr. T. P. Dykstra of the Oregon station, but when planted in the greenhouse at Davis, no calico symptoms developed. The plants did, however, manifest a peculiar type of mottling suggestive of crinkle mosaic. Inoculation made with both the Oregon and Montana plant juice into healthy White Rose and potato seedlings resulted in calico infection apparently identical with the California disease. However, when the Oregon and Montana tubers were planted under cages in the field, characteristic calico developed. Calico-infected tubers were sent to Mr. J. M. Raeder of the Idaho station, who planted them at Moscow in 1931 and in a letter from Mr. Raeder, he states that the California and Idaho diseases appear similar.

Varieties Affected—To date the disease has been found in the field on the varieties White Rose, Bliss Triumph, Idaho Rural, and Garnet Chili. The varieties White Rose and Netted Gem have been experimentally infected.

Environmental Relations.—Under field conditions which apparently tend to mask symptoms of mild and crinkle mosaic, potato calico symptoms are strikingly evident. The exact relations between such factors as temperature, light intensity, etc., and manifestation of symptoms have not been determined. However, symptoms are well defined in the greenhouse, field, and under muslin cages.

Control.—As calico is easily recognized both in the greenhouse and field, either field roguing in the seed plot or tuber-indexing will tend to eliminate diseased stock. Several commercial lots of the variety White Rose have been indexed, the calico-infected tubers discarded and no calico infected plants were found in tuber-unit plots planted with the healthy tubers.

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Some Results of Potato Indexing in Wisconsin

J. W. BRANN, Wisconsin Experiment Station, Madison.

Approximatey 300,000 bushels of very acceptable seed potatoes of the Triumph variety have been produced by Wisconsin growers through the use of seed stock improved by the tuber-index method.

Before this service was instituted by the Horticultural Department of the college, the growers of Triumph seed potatoes had difficulty in meeting the standards for certification because of their inability to eliminate crinkle mosaic.

The work has been in progress for eight years and during that time many of the better growers have received this service. It is through their earnest cooperation that the mosaic content of the Triumph variety has been greatly reduced.

The writer, in this paper, summarizes the benefits of this service, especially in its relation to seed potato certification. Table 1 gives the amount of seed stock indexed for each year and also the amount of increase stocks obtained from this foundation seed.

TABLE 1.

Year Indexed	Bushels Indexed	Bu. 1st Year's Inc. Stock	Bu. 2nd Year's Inc. Stock
1923	25	400	5,000
1924	100	1,200	15,000
1925	125	1,800	25,000
1926	140	2,400	40,000
1927	200	3,200	60,000
1928	175	2,900	45,000
1929	170	2,700	40,000
1930	150	2,200	33,000
Total	1,085	16,800	263,000

During the early period of the work some growers who were located in areas favorable for the spread of mosaic, were forced to abandon their increase seed due to the inroads of the disease. This condition may also have been influenced by the fact that the first stocks indexed contained a comparatively high mosaic content. Tests on the comparative disease content

of increase seed from high mosaic versus low mosaic foundation stock used for index purposes, show that progress is slower when the former is used.

The department has adopted the policy of restricting the index service to growers whose stock is low in mosaic and which has shown marked improvement. This policy is justifiable as it has a bearing on the production of increase stock which, after all, is the source of the bulk of seed potatoes for growers who hope to meet the standards for certification.

Every year one or two growers from the leading Triumph centers are asked to send in tubers for indexing. These growers are selected on the basis of their record in seed production and also on their standing in the community.

The work of Conradi Brothers who are located in one of these centers (Price county), is given as an example of the activities of a single unit in seed potato improvement.

These growers have distributed during the past six years, upwards of 6,000 bushels of superior seed stock, the greater portion of which was used within the county. In 1927, 10 bushels of their Triumph potatoes were indexed. These potatoes produced 180 bushels of stock with a mosaic test of one per cent. Of these potatoes 50 bushels were distributed among six growers who in turn produced 800 bushels of stock low in mosaic. From the above 180 bushels Conradi Brothers retained 130 bushels from which 2,080 bushels of very acceptable seed was produced. These potatoes with those planted by Conradi Brothers produced a crop of 40,000 bushels of excellent seed stock.

These growers send in 20 bushels each year for indexing in order to maintain satisfactory foundation stock. They plant the indexed potatoes in a tuber unit seed plot which is far enough removed from potatoes of an unknown mosaic content to prevent infection. The plot consists of a deep mellow sandy loam or medium loam in good tilth and of sufficient fertility to produce a maximum yield. During the summer, the grower, with the assistance of a member of the potato inspection service, examines the plot for the presence of degeneration troubles or other unfavorable conditions. Unsatisfactory units are removed. The practice above mentioned is representative of the seed growers in the various Triumph community centers.

Growers who have co-operated in this work not only have improved their own potatoes but have stimulated other growers to increased interest in seed selection, disease control, better

culture, and other practices favorable to the production of quality potatoes.

While some difficulty has been experienced in reducing mosaic in some localities, due to infestation of aphids, the results on the whole are indeed gratifying. Table 2 gives the per cent of mosaic in stocks tested and indexed over a period of seven years, for a few representative growers in Triumph seed centers.

This table shows that there has been a gradual decrease, with a few exceptions, in the mosaic content of the potatoes indexed.

From field inspection records of applicants for certification the writer presents data in tables 3 and 4 which show the comparative progress made in the reduction of the mosaic content of Triumph potatoes for the years 1926 to 1931 inclusive. In Table 3 the growers for the various years are classified into various mosaic groups. Table 4 gives the same data expressed in terms of per cent.

Upon examination of Table 4 we observe that there has been a decided increase in the per cent of growers in the low mosaic classification. On the other hand, the data show a decided reduction in the higher mosaic classification. That tuber indexing was responsible for this progress can hardly be questioned.

In connection with the development of improved seed it is interesting to note that the seasonal conditions in 1930 and 1931 which were unfavorable for the best development of the Triumph potato were also most favorable for the maintenance of a low mosaic content in both tuber index plots and commercial field plantings of seed stock. This was due presumably to the low aphid population during these seasons. Hot weather, coupled with low rainfall no doubt were factors in retarding the developmnt of these insects, which under Wisconsin conditions are the chief factors in the spread of mosaic disease.

Because of the above conditions upwards of 25,000 bushels of very acceptable potatoes may be retained by Wisconsin growers who otherwise would be forced to obtain new seed for their plantings in 1932.

THE INDEX METHOD DESCRIBED

The actual work of indexing commences about November 20. Tubers from growers whose stock matures early, receive first attention. This is done to insure early germination of the seed pieces.

TABLE 2.

Growers	Percentage of Mosaic						
	1924	1925	1926	1927	1928	1929	1930
J. W. Smith		4.4	1.7	1.0	0.0		
J. W. Smith		13.0	8.8	4.7	3.5	1.1	1.0
Bert Jackson		7.4	3.7	3.8		0.5	0.2
Conradi Bros.	6.6		2.7	1.1	1.3	.8	.4
B. D. Keiber		13.3	6.0	.1	.7	.8	
Spooner Ex. St.	3.3	1.2	1.7	1.0	1.6	.3	.8
Imbach Bros.	30.3	4.4	1.7	1.0	0.0	0.0	

Table 3. Classification of applicants for inspection into various mosaic groups.

Mosaic Groups	1926	1927	1928	1929	1930	1931
0 to 2% inclusive	12	17	56	116	85	106
3 to 5% inclusive	16	23	45	19	9	8
6 to 10% inclusive	22	25	20			

Table 4. Classification of applicants in table 3 expressed in terms of per cent.

Mosaic Groups	1926	1927	1928	1929	1930	1931
0 to 2% inc.	18%	26%	46%	86%	90%	94%
3 to 5% inc.	23%	35%	37%	14%	10%	6%
6 to 10% inc.	37%	38%	16%			

In the operation of indexing each tuber is numbered carefully with an indelible pencil and one eye piece approximately 1¼ inches in diameter and ½ inch deep is removed. The eyepiece is removed from the stem end of the tuber. Results of experimental work conducted by the writer on comparative infection of stem and bud ends of tubers indicate that more accurate results are obtained with this method. Planting is done in pots or greenhouse flats containing well prepared, fertile

soil. Numbered labels serve to identify the seed pieces. The pots or flats are then placed on a sand base in the greenhouse.

Germination is hastened by exposing the pots or flats to a temperature of 70° to 75° Fahrenheit. After the plants begin to appear the temperature is reduced to 60° F. and this is maintained during the growing period. When the plants are six to eight inches in height disease records are taken and other significant conditions as germination, stand, and general vigor are noted. After the records are completed the tubers corresponding to the plants showing undesirable conditions are removed and the healthy tubers are returned to the grower who plants them in a tuber unit seed plot, the care of which has already been discussed.

Some of the more experienced growers are asked to send numbered eye pieces instead of tubers. These are strung bead-like in consecutive order in groups of ten or twenty. This method has the advantage of reducing frost hazards in transit and labor costs connected with handling tubers. In addition, there is no exposure of the tubers to varying temperatures incident to shipping and handling operations.

Indexing of one or more tubers from selected hills is a practice which has also been followed. While one or two tubers are not always a true index of the disease conditions in the hill, satisfactory progress has been made with this system when stock of a low mosaic content is used.

Crop and Market News

A MODERATE CROP OF POTATOES

(Contribution from the Department of Agricultural Economics)

With the total United States potato acreage only 1% greater than that of last year, indicated production according to July condition was about 378,000,000 bushels, compared with the revised 1931 total of 375,518,000 and an average of 361,000,000 bushels for the period 1924-1928. Estimated acreage and indicated production in the late states were both about 4% larger than a year ago. Greatest increases of acreage are in a number of the central states.

Among the surplus-producing late-potato areas, the three eastern states expected 90,000,000 bushels, or 15% less than

last year. The five central states looked for 103,000,000 bushels, or 17% more than in 1931. The ten western states expected 80,000,000 bushels, an increase of 18% over their 1931 crop. The 18 late surplus-producing states together had an indicated production, according to the July forecast, of 272,000,000 bushels, compared with 262,000,000 last year, a net gain of only 4%. The 12 other late-potato states, which usually do not produce sufficient for their needs, expected about 38,500,000 bushels, or only 2,000,000 more than in 1931. Total production in seven intermediate states, which were shipping during the summer months, was indicated as 3,000,000 bushels, or just slightly less than last year.

Shipments of new potatoes had been running between 4,000 and 5,000 carloads per week during early July, and they were considerably lighter than a year ago. Adverse weather conditions in the Middle West and the closing of the active shipping season in Virginia brought about a sudden and sharp reduction of shipments for the week of July 17-23, when only 2,200 cars moved to market. Intense heat had caused digging to come almost to a standstill in Kansas and Missouri, so that those two states together shipped only 335 carloads during the third week of July, compared with four times that many cars the preceeding week. The prolonged heat wave also caused much damage to midwestern potatoes, and many cars were arriving in bad condition. Markets were very weak and prices low around the 25th of July. Some entire cars of poor stock, badly decayed, sold for only $5 in Chicago, though the general price of fair stock from Kansas or Missouri in that carlot market was 50c-60c per 100-pound sack, with other cities reporting jobbing sales at 80c-$1.15. However, shortly after the 25th of the month, prices began to improve and Chicago quoted Kansas Cobblers at 75c-85c per sack. Southern Bliss Triumphs jobbed at 75c-$1.50 per sack, with Chicago market on Idaho Triumphs at $1.65-$1.75. F. o. b. prices of Kansas and Missouri Cobblers were as low as 55c per 100-pound sack during the period of greatest depression, but the market later strengthened.

Eastern Shore of Virginia and Maryland Cobblers reached a low of $1.25-$1.30 per barrel, f. o. b. shipping points, and then advanced to a range of $1.35-$1.50 by July 25. City dealers were getting $1.25-$2.40 per barrel of Virginia Cobblers, with receipts from Maryland at $1.75-$2.25. New Jersey Cobblers were beginning to sell in terminal markets at $1.75-$2.25 per barrel or $1-$1.10 per 100-pound sack, with New York City dealers getting $1.10-$1.25 per sack of Cobblers from Long Island. Detroit quoted Kentucky potatoes at 90c-$1 per 100-

pound bag. Prices of eastern stock were slightly lower than a year ago, but midwestern potatoes were bringing only about half what they did in July, 1931. And this in spite of the much lighter supplies this year on the potato market in general. Total forwardings of new potatoes to July 23 had amounted to 38,900 cars, compared with more than 63,000 the year before. However, the output of Kansas and Missouri this season was about double that to the same time last year.

A remarkable feature of the market this season was the prolonged movement of old-crop Green Mountains from northern Maine. In 1931, the shipments of Maine potatoes from storage were finished about July 4, but movement from that state during the first three weeks of July, 1932, was 240 cars, 140 cars and 16 cars respectively. Jobbing prices in terminal markets declined toward the end of the season to a range of 60c-75c per 100 pounds sacked. In spite of low prices and unfavorable marketing situation, the total shipments from Maine for the 1931-32 season were about 53,200 cars, or only slightly less than output of the preceding season when the crop in that state was 11% lighter than the 1931 crop.

Notes

CANADA

Certified Seed Production

There is a considerable reduction in the amount of potatoes entered for field inspection with a view to certification in 1932, as compared with 1931. The number of fields entered is 8,120 as compared with 11,309 for last year. The acreage entered is down by 29 per cent from last year's total and amounts to 27,286 acres as compared with 38,424 acres entered in 1931. The principal varieties affected are Irish Cobblers down 5,131 acres, Green Mountains down 4,933 acres, Rurals down 333 acres. Apparently the small premium obtainable for Certified Seed over table stock last season was considered insufficient by many of the growers to warrant the additional time and work expended in the production of high class seed.

Table Stock Production

The Federal Bureau of Statistics states that the acreage planted to potatoes is 543,700 as compared with 583,926 acres in 1931, which represents a decrease of 7%. Quebec is the only province reporting an increase. The estimated acreage by provinces for 1932 as compard with 1931 is as follows:

	1931	% of 1931	1932
Prince Edward Island	54,272	73	40,000
Nova Scotia	21,394	94	20,000
New Brunswick	59,263	79	47,000
Quebec	144,400	102	147,000
Ontario	169,604	93	158,000
Manitoba	37,300	97	36,000
Saskatchewan	41,732	100	41,700
Alberta	35,596	97	35,000
British Columbia	20,365	94	19,000
	583,926	93	543,700

—JOHN TUCKER.

Review of Recent Literature

Jehle, R. A., and Sanders, P. D. Potato Production at Lower Costs by Disease and Insect Control. University of Maryland Extension Bul. 58, September 1931.

Statement is made that cost of production can be greatly reduced by controlling diseases and insect pests. The annual loss from these pests to Maryland potato growers is between $1,000,000 and $2,000,000. The authors made five recommendations by following which this loss can be reduced: (1) Plant only best certified seed, (2) Cull out diseased and injured tubers, (3) Treat seed with proper chemicals before planting, (4) Practice four-year rotation where soil-borne diseases are prevalent, (5) Adopt a regular spraying or dusting program. Detailed directions are given for following out each of the above recommendations, also a brief description of the more important diseases and insect pests. E. V. HARDENBURG.

Fulton, B. F., Mann, H. B., Poole, R. F. and Schmidt, R. Approved Practices for Irish Potato Growers. North Carolina Exp. Sta. Bul. 279. January 1932.

The bulletin gives a list of recommendations concerning choice of varieties, seed, seed treatment, soil fertilizers, cultural methods, harvesting, storage, and pest control. These recommendations are made briefly, in seasonal order, and without much discussion. E. V. HARDENBURG.